ADOPTION AND IMPLEMENTATION OF SCIENCE-TECHNOLOGY-SOCIETY THEMES BY KANSAS MIDDLE SCHOOL SCIENCE TEACHERS

by

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CHAPTER I

INTRODUCTION

The National Science Teachers Association re-defined science education as science-technology-society (STS) education in its position statement of 1982. This change in terminology was "intended to provide a focused approach for the revitalization, development, and improvement of science education programs and to provide guidance for "science educators at all levels, textbook publishers, and government policy makers." (NSTA, 1982, p.1). This name change was also adopted by the National Science Foundation (1985), the National Science Board Commission on Pre-College Education in Mathematics, Science and Technology (1983), the National Commission on Excellence in Education (1983), and a host of authors (Bybee, 1977; Anderson, 1983; Harms & Yager,1981).

The change in emphasis in science education followed closely on the recognition that a crisis exists in science education. As a number of reports indicated the quality and quantity of science education for all citizens is not commensurate with the current status of science and technology in society (NSTA,1982; National Commission on Excellence in Education,1983).

Despite the widespread acceptance of science-technology-society education as the conceptual framework for

science education in the 1980's teachers have not begun to put this into practice (Bybee & Bonstetter,1985).

This research project examined two relationships:

a) that between support for STS themes by middle school science teachers and teacher characteristics; and

b) the inclusion of STS themes by middle school science teachers and teacher characteristics.

Statement of the Problem

This study was concerned with the relationship between amount of time for preparation and individual teacher characteristics that influence the adoption and implementation of STS in the middle level (grades 7 and 8) science curricula. The National Science Teachers Association recommends that a minimum of 18% of instructional time in middle level science classes be devoted to the application of scientific and technological knowledge and methods to personal life. NSTA also recommend a minimum of 15% of science instruction be directed toward science related societal issues (NSTA, 1982, p.4).

Despite the NSTA recommendations which have been in place for more than three years and indications by teachers that STS in very important in the curriculum, science-technology-society issues are not being taught to the extent that the experts recommend. By looking in general at the question "Why does the discrepancy exist?", this study was designed to answer the following specific questions:

1. What is the relationship between the amount of

teacher preparation time and the adoption of science-technology-society (STS) themes?

2. What is the relationship between the amount of teacher preparation time and the implementation of science-technology-society (STS) themes?
3. What is the relationship between internal teacher characteristics (those which a teacher controls) and the adoption of science-technology-society (STS) themes?
4. What is the relationship between internal teacher characteristics and the implementation of science-technology-society (STS) themes?
5. What is the relationship between external teacher characteristics (those which the teacher does not control) and the adoption of science-technology-society (STS) themes?
6. What is the relationship between external teacher characteristics and the implementation of science-technology-society (STS) themes?

Hypotheses

The following eight hypotheses were examined:

1. There is no relationship between middle school science teachers adopting STS themes in their curricula and preparation time.
2. There is no relationship between middle school science teachers implementing STS themes in their curricula and preparation time.

3. There is no relationship between middle school science teachers adopting STS themes in their curricula and internal teacher characteristics.
4. There is no relationship between middle school science teachers implementing STS themes in their curricula and internal characteristics.
5. There is no relationship between middle school science teachers adopting STS themes in their curricula and external teacher characteristics.
6. There is no relationship between middle school science teachers implementing STS themes in their curricula and external teacher characteristics.
7. There is no single combination of preparation time, internal teacher characteristics, and external teacher characteristics that best predicts the adoption of STS themes by middle school science teachers.
8. There is no single combination of preparation time, internal teacher characteristics, and external teacher characteristics that best predicts the implementation of STS themes by middle school science teachers.

Operational definitions

Preparation-time: the number of minutes available each day to a teacher during the school day with no class or supervision duties.

Internal teacher characteristics: those characteristics of

the professional teacher which the individual has control over. This study looked at the following internal characteristics:

- -membership in professional organizations
- -participation in professional organizations
- -adequate background to teach selected STS themes
- -awareness of world and scientific events as indicated by reading newspapers, journals, and magazines
- -years of teaching experience
- -academic degree
- -degree of dependence on textbook as curriculum guide

External teacher characteristics: those characteristics of the professional teacher which the individual has little or no control over. This study looked at the following external characteristics:

- -age
- -district support in the form of release time, funding, or seminars
- -building administrative support for change and innovation
- -building administrative support for STS themes
- -building administrative encouragement for change and innovation.

Definition of terms

(These definitions come directly from Bybee, 1985, pages

86-87, from a chart of definitions developed by Bybee and Hickman.)

Science-- A systematic, objective search for understanding of the natural and human world. A body of knowledge, formed through continuous inquiry. Science is characterized by use of an empirical approach, statements of generality (laws, principles, theories) and testing to confirm, refute, or modify knowledge about natural phenomena.

Technology-- The application of scientific knowledge to solve practical problems to achieve human goals. A body of knowledge, developed by a culture, that provides methods or means to control the environment, extract resources, produce goods and services, and improve the quality of life.

Society-- The collective interactions of human beings at local, regional, national, and global levels. Human groups whose members are united by mutual interests, distinctive relationships, shared institutions, and common culture. The human setting in which the scientific and technological enterprise operates.

Relationship of Science and Technology-- Knowledge generated by the scientific enterprise contributes to the development of new technologies. New technologies influence the scientific enterprise, often determining research problems and the means employed to solve them. Technological developments lead to improved methods and instruments for scientific research.

Relationship of Science and Society-- The knowledge produced by science and the processes used by scientists influence our world view-- the way we think about ourselves, others, and the natural environment. Scientific knowledge has both positive and negative social consequences. The impact of science on society is never entirely beneficial and rarely uniformly detrimental. The impact varies with individuals, populations, places, and times. Society's problems often inspire ideas and questions for scientific research. Research priorities are influenced by requests for proposals, grants, and funding through public and private sources. The social context affects the reception of new ideas, and social factors within the science community influence the research undertaken and the acceptance of new findings. Science-related social controversies usually center on issues of research priorities and proprietorship of knowledge.

Relationship of Technology and Society-- Technology influences the quality of life and the ways people act and interact locally, nationally, and globally. Technological change is accompanied by social, political, and economic changes that may be beneficial or detrimental to society. The impact of new technology is never entirely beneficial and rarely uniformly detrimental. The impact varies with individuals, populations, places, and times. Social needs, attitudes, and values influence the direction of technological development. Technologies often arise in

response to cultural values and serve the needs of dominant social groups. Social control over technology is seen in demands for the development or assessment of new technologies. Technology-related social controversies usually center on issues of efficiency, equitability, benefit, risk, and regulation.

Relationship of Science, Technology, and Society-- Science and technology have influenced social development throughout history at all levels of society. The most direct interactions are between technology and society, but the technology is made possible by scientific knowledge (technology is in fact applied science). While science and technology are distinct, they are so intertwined that most interactions between either and society in practice involve all three.

Limitations

This study was limited by time and manageability. A survey sent by mail could provide better, more detailed results if it were replaced by interviews and classroom visits. Although a mailed survey helps eliminate the biased reactions possible in an interview, the following risks occur:

1. Surveys yield data only from respondents who are accessible and cooperative.
2. Surveys generate "response sets" such as a propensity to agree with positive statements.
3. Surveys are vulnerable to over-rater or under-rater

bias (the tendency to give consistently high or low ratings).

4. The data is all self-reported and questions are open to interpretation by the reader.
5. In order to run the multiple regression techniques it was assumed that all of the relationships were linear.

Amount of preparation time available and the teacher characteristics selected are only a small section of the possible range of factors that could affect the adoption and implementation of science-technology-society themes. It is not assumed that these other factors are not relevant. The researcher intended to consider only a few isolated factors to begin to answer a larger, more complex question.

CHAPTER II

LITERATURE REVIEW

Re-statement of the Problem

This research was designed to identify the correlations between the adoption and implementation of science-technology-society themes by middle school science teachers and preparation time, internal teacher characteristics, and external teacher characteristics. In addition, once these correlations were identified the researcher attempted to determine which variable accounted for significant amounts of variance. The conceptual framework and identified variables come from the related literature as described below.

Review of Related Literature

History of Science-Technology-Society Education

Science education is in a state of change and this seems to be the more the rule than the exception. Both Shroyer (1984) and Rosenthal (1985) have commented on the cyclic nature of science education, particularly in reference to the ideas that appear in the literature. The number of changes that actually affect classroom practices is much lower than the number of ideas batted around in the writings concerned with science education.

In the United States public education started around

1750. From that time until 1850 the aims of science education were description, utilitarian, and religious (Bybee, 1977b). In contrast Benjamin Franklin and Thomas Jefferson were writing that science education should encourage progress and aid the individual (Bowman, 1935; Blinderman, 1976).

From 1850-1910 the literature cried for science educators to incorporate social issues into their teachings (McMurry, 1895). But in reality the practices of science education did not reflect this new direction (Bybee, 1977b). This emphasis on science and society in the literature continued through 1935 and gradually science teachers began to incorporate the scientific method into their classrooms as the social reconstructionist philosophy emerged (Shroyer, 1984).

From 1935-1950 World War II greatly influenced science education. Science instruction was seen as a vehicle to develop the minds that could help solve the economic and social problems of the world (Henry, 1947). Despite the lofty goal, science teachers were still emphasizing the acquisition of knowledge as the major component of their classes until late in the forties. Gradually textbooks began to emphasize the interplay between science and society (Del Giorno, 1969). Ironically the literature was beginning to focus on a new idea (Shroyer, 1984).

The combination of the 1957 launching of Sputnik I and dissatisfaction with schooling produced a new emphasis in

the curriculum that extended through the early 1970's. This new focus was on developing specialists and encouraging America's brightest and best. The struggle to get ahead was on and science-technology-society issues disappeared in the wake.

Current Status of Science-Technology-Society Education

In the last ten years science education has gradually come to be defined as science-technology-society education (NSTA, 1982). This redefinition describes the general direction of change. Rather than the hardcore, theoretical science for the elite that evolved after the Sputnik crisis, science education for the eighties and beyond is a program designed to make science relevant and understandable for all citizens. This new direction has been described, defined, and recognized by educators, government agencies, and professional organizations.

In order to establish the theme of science-technology-society (STS) education much discussion has occurred. One of the focuses of the discourse has been the need to address America's decline in interest and achievement in science by pre-college students. The National Science Board Commission on Pre-College Education in Mathematics, Science, and Technology (1983) considers scientific and technological literacy critical to understanding the world today. They recommend a stronger national commitment to science and technology education for

all as well as earlier and increased exposure to those fields.

Anderson (1983) sees the need for new science education goals that will reflect the current world situation while preparing students to face the world of tomorrow. To prepare students they must be aware of scientific and technological matters and their impact upon society. These ideas are supported and described by many authors (Bybee, 1977a; Bybee, 1985; Gardner & Yager, 1983; Harms & Yager (eds.),1981; Kromhout & Good, 1983; Miller, 1984; National Commission on Excellence in Education, 1983; Thier, 1985; Yager, 1983; Yager, 1984; Yager, 1985).

According to the comprehensive review of U.S. science education done during Project Synthesis, the goals of science education fall into four categories: personal needs, societal issues, academic preparation, and career preparation. Science-technology-society themes fall nicely into place with these four goals. STS themes and issues relate to students' lives now and in the future, affect society as a whole, require an understanding of basic science concepts, and alert students to possible careers because of the references to technology. Yet, Project Synthesis discovered that science teaching focuses almost exclusively upon the third goal: that of academic preparation. In addition, in high schools this goal tends to be pursued only by the college bound (Harms & Yager, 1981; Anderson, 1981). This does not help further the goal

of science-technology-society education for all citizens.

Teachers, as well as researchers, also indicate support for science-technology-society education. In a survey of 317 science teachers (41% high school, 25% middle/junior high school, 27% elementary) over 97% said they would incorporate the STS theme into their science program if the materials and instructional strategies were available. And yet, these same teachers indicate that only some or very little STS is being taught in their schools (Bybee & Bonstetter, 1985; Bybee & Bonstetter, (in press)). The lack of inclusion of up-to-date science-technology-society material is reflected in student preparation also. The 1976-77 National Assessment of Educational Progress revealed a low level of knowledge in the area of science-technology-society issues (1978). In 1981-82 the Science Assessment and Research Project found that scores of nine year olds improved but thirteen year olds knew less about the applications of scientific research to societal issues than those in 1977. Seventeen year olds in 1982 were aware that science influenced their lives but understood much less than the same age group in 1977 (Blosser, 1983). There appears to be a great distinction between what is commonly accepted as the way things should be and the way they appear to be.

Adoption and Implementation

The time lag between what is accepted as how things should be and what actually exists may be due to what Bybee (1977a) calls the change process. He points out that the

change process in science education takes place in five steps:

> 1. The development of new perceptions of science teaching based on the societal needs that education is not meeting.
> 2. The establishment of new perceptions through publications by significant people.
> 3. The working out of theoretical constructs of the new model.
> 4. The construction of curriculum materials based on the new model of science teaching.
> 5. The process of implementation (p.91).

Fullan (1982), in contrast, identifies three phases of change in education:

1. The process leading up to and including the decision to adopt or proceed with a change. This most often includes actions labeled initiation, mobilization, or adoption.
2. Implementation or first use, which encompasses the first two or three years of use. This is one's first experiences of putting a program into practice.
3. Continuation, which means the incorporation or institutionalization of the change so it becomes an ongoing part of the system.

These three phases overlap with and extend beyond steps four and five in Bybee's plan. Perhaps one of the problems related to the adoption and implementation of science-technology-society themes into science classrooms is that science educators are glossing over the factors affecting adoption and implementation.

Fullan (1982) identifies ten factors which affect adoption. He says the presence or absence of these various

factors influences decisions to reject or adopt programs. These ten factors are:

1. existence and quality of innovations
2. access to information
3. advocacy from central administrators
4. teacher pressure/support
5. consultants and change agents
6. community pressure/ support/ apathy/ opposition
7. availability of federal or other funds
8. new central legislation or policy (federal, state, or provincial)
9. problem solving incentives for adoption
10. bureaucratic incentives for adoption (1982, p. 42).

Implementation, because it is a <u>process</u>, was much more complicated aspect to examine. Fullan (1982) divides the factors affecting implementation into four major headings with fifteen sub-groups as follow:

A. Characteristics of the Change
   1. Need and relevance of the change
   2. Clarity
   3. Complexity
   4. Quality and practicality of program

B. Characteristics at the School District Level
   5. The history of innovative attempts
   6. The adoption process
   7. Central administration support and involvement
   8. Staff development and participation
   9. Timeline and information system (evaluation)
   10. Board and community characteristics

C. Characteristics at the School Level
   11. Principal
   12. Teacher--teacher
   13. Teacher characteristics and orientations

D. Characteristics External to the Local System
   14. Role of government
   15. External assistance (p. 56).

Science-technology-society education seems to be stuck between numbers four and five of Bybee's plan and is still

back in phase one of Fullan's description of educational change. There are scattered pieces of curriculum available, but nothing widespread and textbooks definitely do little more than lip service to STS themes. This lack of curricular support and teachers' willingness to use these incomplete textbooks was documented by the National Science Foundation. In 1979, they found that 90% of teachers were using a traditional textbook approach that stressed content over methods and virtually ignored the interfaces between science, technology, and society (Harms & Yager, 1981). One of the possible roadblocks could be the failure of science education research to affect the practice of science education (Yager, 1984). This disdain for research among science teachers increases their reluctance to change, regardless of the number of authors indicating the importance of science-technology-society education.

When Goodlad (1984) surveyed 1350 teachers he found that "over 75%, regardless of subject area taught or level of schooling, indicated that they were greatly influenced by two sources-- their own background, interests, and experiences; and students' interests and experiences" (p.186). This statistic emphasizes the lack of influence science education research has had on practicing science teachers. These same teachers reported that they were moderately influenced by "textbooks and other commercially prepared materials, state and district curriculum guides... and other teachers" (p. 186-187). District consultants,

parent advisory councils, state examinations, and teacher unions had slight or no influence.

Goodlad (1984) also noted that teachers reported that the amount of control they had over each of the following items decreased as listed: setting goals and objectives, selecting content and skills to be taught, use of classroom space, grouping students for instruction, choosing instructional materials, and scheduling the use of time. If one puts these pieces of data together it appears that teachers do feel capable of determining what is taught in their own classrooms but they tend to choose those skills and content based on either how they have been taught or what they have been taught.

Teachers themselves have indicated that science should not be mixed with other topics (Bybee & Bonstetter, 1985). In other words, the inclusion of issues affecting society should not be part of the science curriculum regardless of their scientific backgrounds. This is not a consistent theme among science teachers but may represent another of the roadblocks in the change process. Other factors slowing down the process of change include the traditional nature of textbooks, teachers' unawareness of STS themes, and lack of time to explore new ideas (Bybee & Bonstetter, (in press); Harms & Yager, 1981).

In order to successfully complete step five of the change process these roadblocks must be understood more completely. This research attempted to identify and quantify

the factors that prevent implementation. The research focused on middle level science teachers because that seems to be the most promising level at which to implement STS themes.

Middle School Science

Thier (1985) points out that early reform efforts will be focused on the high school level because of the current low enrollment in science courses. However, these low enrollments can be traced back to a sharp decrease in student interest in science during middle school (NAEP, 1979).

Middle level science is an ideal time to begin covering science-technology-society issues in more depth for several reasons. First, the learners are at a point in their intellectual and social development when they are interested in what is happening around them, particularly if it pertains to their family or community. They have an idealistic view of the world and are more likely to get involved in social change projects. Second, middle school curriculum tends to be exploratory in nature and not rooted in a traditional base. This characteristic permits more flexibility for classes with an interdisciplinary approach. Third, middle level teachers tend not to be single subject specialists and see their teaching in the context of more general all-encompassing goals. Again the science-technology-society approach blends perfectly with this philosophy since it is oriented around preparing

citizens who are informed and capable of making sound decisions (Their, 1985).

Support for this concept comes from outside the middle school also. The National Science Board Commission (1983) recommends a full year of science and technology be required in grades seven and eight. The National Science Teachers Association (1982) recommends 15% of science instruction at the middle school level be spent on STS themes. A survey of science teachers also indicated support for the NSTA recommendation (Bybee & Bonstetter, 1985).

Science-Technology-Society Education in Kansas

The Kansas State Department of Education also expressly supports the concept of science, technology, and society and includes it as part of the state curriculum guide. One of the goals for science education in Kansas states: "The cognitive domain can be further sub-divided into knowledge about science, which includes the nature of science, concepts within science, and the interaction between science and society, and the processes of science" (1984, p. v). Clearly, in Kansas knowledge about science means covering more than the factual information traditionally focused on in science classrooms. The state guidelines include the interaction between science an society, a major component of STS education, as one of the critical portions of the larger topic "knowledge about science."

These ideas are further elaborated in two later sections of the state guidelines for science education.

Under Overall Science Objectives and Skills objective iii states that science teachers should "create an awareness of the total environment and how the environment affects the student." Program Outcome Objective 4 says that students will be able to "demonstrate the use of scientific knowledge and processes to clarify his values, examine issues, solve problems (both personal and social) and to satisfy personal curiosity." Objective 5 says that students will be able to "relate science learning to the planning and fulfilling of personal, social and career roles" (1984, p.7). These objectives are well founded in both intention and the literature but unless teachers are attempting to accomplish them these guidelines are of little value. A willingness to include (adoption) followed by the actual inclusion (implementation) of science-technology-society themes in middle level science classrooms in Kansas will go far in accomplishing the state developed guidelines.

If one follows the steps of Bybee's change process, it appears that step one, a new perception of science teaching has developed. The perception of science education as science-technology-society is firmly established in the literature as required in step two. The theoretical constructs of the new model are gradually being worked out, which is step three. Step four, the development of curriculum materials has begun, though generally not as a part of textbooks. But the processes of adoption and implementation, step five, have barely begun and are moving

slowly. Current efforts in science education research need to be focused here.

Summary of Key Variables

The literature suggests a number of variables to be studied when examining adoption and implementation. This research focused on the few that could be examined by a survey of middle school science teachers.

In particular, this research looked at numbers two, three, four, and eight from Fullan's list of factors influencing adoption (1982). Access to information was examined by seeking teachers' opinions of the adequacy of their schools' libraries and by recording how often teachers read a variety of materials. This is not an exhaustive list of the possible sources of information teachers have access to for science-technology-society information.

The third factor Fullan identified was advocacy from central administrators. This research examined advocacy only in terms of support and encouragement from building level administrators. Teachers were also asked to note what opportunities their district would need to make available to enable them to change their curricula.

To examine the fourth factor, teacher pressure or support, teachers were directly asked how much they supported the concept of science-technology-society. And the eighth factor, new central legislation or policy, already exists in Kansas as will be described below in the discussion of the state guidelines for science education.

Goodlad's research indicated that this will probably not be a major influence on teachers' curricula decisions (1982).

This research began to examine primarily factors four, eleven, and thirteen of the change process as described by Fullan (1982). Quality and practicality (factor 4) were reviewed only in terms of time available to the teacher to make a change. Characteristics of the principal (factor 11) were briefly examined by asking teachers how much they thought their principals encouraged change. Fullan (1982) claims that although principals enhance the likelihood of change most do not play instructional leadership roles. One of the focal points of this research has been factor 13, or teacher characteristics. In other words, what is it about a teacher that makes it more likely that he or she will implement science-technology-society themes. Doyle and Ponder (1977) also discuss these ideas under the general concept of "practicality ethic."

CHAPTER III

METHODOLOGY

Overview of the Study

This study was designed to survey Kansas middle school science teachers and determine the relationship between adoption and implementation of science-technology-society themes in their curricula and preparation time, internal teacher characteristics, and external characteristics. After establishing these correlations the variations will be identified and quantified.

Subjects

A list of Kansas middle school science teachers was obtained from Continuing Education at Kansas State University. This list was generated from a computer file of Kansas teachers by placing the following two descriptors on the file: junior high and natural science teachers. This produced 465 names of middle level science teachers. All members of this group were contacted by mail with a survey and cover letter. Thirteen surveys were returned as undeliverable or no longer teaching middle level science so the final sample size was 452 teachers.

Description of Subjects

Two thirds of the respondents were male and one third female. The mean age range was 41-45 years old. The mean experience range was 11-15 years. Most teachers had 200 - 500 students in their buildings and more than one thousand

students in their districts.

Development of the Instrument

In order to conduct this research a specific instrument combining questions about science-technology-society and adoption and implementation had to be developed. As Finson discovered "a number of instruments have been developed which contain some items dealing with STS, but no single instrument appears to focus exclusively on STS" (1985, p. 40). Since the time of Finson's review of existing instruments several STS surveys attempting to measure attitudes and literacy have appeared (Bybee, 1984; Bybee & Bonstetter, 1985; Powell & Bybee (in press)). It was these surveys that formed the foundation of the instrument developed for this research. It was necessary to develop a new instrument that measured factors affecting adoption and implementation since the older instruments only measured attitudes and literacy. This new survey used the STS topics and a format of the older surveys.

Preliminary validation for content and clarity took place in two steps: first, the researcher's committee consisting of Dr. Emmett Wright, Dr. Larry Enochs, and Dr. Joseph Graf, all of Kansas State University, reviewed the questions and offered suggestions for improvement. Second, four Ph.D. students in science education examined the survey for thoroughness, clarity, and appropriateness. These people (Ahmed Alwan Al-Madhagi, Mary Rubeck, Gail Shroyer, and William Stalheim) offered a number of comments to

improve the clarity and appropriateness of the instrument.

After the initial adaptation of the survey questions by science education professors and graduate students at Kansas State University, a second version of the survey evolved. This instrument was sent to a panel of five content experts chosen for their extensive involvement and publications in the area of science-technology-society education. (See Appendix A for cover letter, validation instrument and validation results. Appendix B contains the validation experts and their qualifications.)

When all of the validation instruments were returned a third version of the instrument was produced. (See Appendix C for an example of this survey.) This version was sent to all Kansas middle school science teachers with a cover letter explaining the purpose of the instrument. (See Appendix D for an example of this cover letter.)

Reliability was established after the data was collected by means of the Cronbach alpha test from the SPSSX computer package. Because of the nature of the questions on the instrument only four were appropriate to test for reliability. For these questions the reliability coefficient was 0.9219.

Research Design

The design for this project was developed as correlational research. After establishing the correlations the degree to which a relationship exist, the dependent variables were adoption and implementation of science-

technology-society themes. Adoption was measured by yes/no answers to a question asking teachers if they would like to include any of a series of science-technology-society topics in their curriculum. Implementation was measured by a similar question which asked teachers to indicate the science-technology-society topics already included in their curricula. All "yes" answers were given one point, "no" answers zero points and then these points were totaled to provide a continuum for the analysis of variance. These units were plotted against the independent variables: amount of preparation time, membership in an organization, participation in an organization, teacher background in STS areas, awareness of issues, age, years of teaching experience, educational background, dependence on textbook, district support, building administrator support, building administrator encouragement. (See Chapter I for operational definitions.)

To provide more information about the dependent variables the instrument contained questions aimed at providing more detail; these questions were analyzed using standard descriptive statistics.

Method of Sampling

The instrument of this study was a survey designed to gather information that describes the amount of preparation time and internal and external characteristics of middle school teachers. That data will then be used to examine the relationships between those variables and the extent of

adoption and implementation of STS themes taught in middle school science classes in Kansas.

The survey design incorporated the following characteristics:

1. Systematic- planned to insure appropriate content coverage and efficient data collection.
2. Objective- insuring that the data are obvious and explicit.
3. Quantifiable- yielding data that is expressed in numerical terms (Isaac & Michael, 1981).

To ensure that these characteristics were met the survey contained primarily close-ended questions and questions that could be answered numerically. To provide an opportunity for elaboration some questions were accompanied by optional open-ended questions.

The survey was sent to 465 middle level science teachers on April 21, 1986. Within 10 days 35% of the teachers had responded so following Fowler's recommended procedure for mailed surveys a reminder postcard was sent on May 9, 1986 (1984, p.54). (Appendix E contains an example of this reminder card.) To enhance the response rate a random sample of 60 non-respondents were sent a second letter and survey on May 16, 1986. (See Appendix F for an example of second letter.)

After these measures a final response rate of 39% was received. A t-test was run between the initial respondents and the secondary respondents to determine any significant

differences that might exist between the respondents and the non-respondents. The t-test produced no significant differences between the groups. With this statistical support and the homogeneity of the group it is assumed the results represent the population surveyed despite the low response rate.

Data analysis

The data was input into the computer. The descriptive statistics, correlation, multiple regression and factor analysis programs of the Statistical Package for the Social Sciences (SPSSX) were used to establish any significant relationships among the variables and the degree to which relationships exist between the dependent and independent variables (Norusis, 1985). These results are discussed in Chapter IV.

In addition to these procedures the open ended questions were examined by content analysis (Krisendorff, 1980). In this procedure all answers are recorded and then grouped into general categories which are examined for support of other statistical evidence as well as for how well they explain trends in the research.

CHAPTER IV

RESULTS

Introduction

The statistical findings for this study had three purposes: first, to provide descriptive information about the sample; second, to establish relationships between the dependent and independent variables; and third, to explore the possible significance of these relationships. Analysis of the data used a variety of procedures because of these different purposes.

The first procedure used was standard descriptive statistics reporting means, ranges, and frequencies. This information will be discussed first to provide knowledge about the teachers sampled and the conditions under which they teach. Two descriptive items were covered by open-ended questions and these were examined via content analysis rather than conventional statistical methods. The information yielded is similar to that derived from the more traditional descriptive items so these results will be discussed in the same section.

Significant and interesting correlations will he discussed in the second section. These correlations were identified from the the correlation matrix preceding the multiple regression technique employed.

In order to make predictions about the variable relationships three different types of analysis were inured.

Stepwise regression was used to examine the cumulative variance accounted for by each significant variable. The full regression technique allowed the researcher to see the total variance accounted for by all of the independent variables but does not account for areas of shared variance. Finally, factor analysis of the data was run to determine if any groups of variables could be considered as new individual variables in a second stepwise regression procedure.

Descriptive Information

What do they teach?

Eighty-seven people or 57% of the respondents reported that they taught life science an average of 3 sections per day (mean = 2.87). Sixty-nine people or 45% taught earth science, again averaging 3 sections per day (mean = 2.58). Forty-nine per cent of the respondents taught physical science at just over three sections per day (mean = 3.1). Only 18% (27 people) taught general science and they also averaged 3 sections per day (mean = 2.89). Twenty-four per cent of the respondents reported that they taught something other than the traditional middle school courses mentioned above. These courses ranged from five sections of physical education to one section of Current Events in Science. Please refer to Appendix G for the specific details of these responses.

Preparation Time

The average number of preparation periods per week was

4.6 with a minimum of 0 and a maximum of 9. This works out to less than one period per day. The periods average 47 minutes long with a range between zero and sixty minutes. This preparation period was generally part of a seven period day balanced by five periods of teaching and one period of supervision. Occasionally there was a rare situation where the teacher taught seven out of seven periods or for some other reason had no preparation time (5%). On the other hand, 1% of the respondents indicated that they had two preparation periods per day. This generally allowed time for team teachers to plan or department chairpersons to tend their responsibilities.

During this hour or less of preparation time most of the teachers had three different courses to prepare for (mean = 2.97). The average length of these classes was 50 minutes with a mean lab period of 48 minutes.

When asked how they use their preparation time the two most common answers were grading and preparing existing units. However, given the large standard deviation this may not be significant. "Other" responses had a high ranking from the twenty-three respondents who filled in a response. These answers varied greatly; only administrative details and supervision had multiple responses. The least common activity was previewing audio-visual material. For a complete ranking of how middle school science teachers spend their preparation time please refer to Table 1.

Teachers were also asked how they would use additional

TABLE 1

USE OF PREPARATION TIME

ITEM	MEAN RANK	&	STANDARD DEVIATION
grading	2.3	±	1.6
preparing existing units	2.6	±	1.6
other	2.7	±	2.9
setting up or preparing labs	3.4	±	1.8
planning new units	3.5	±	1.9
cleaning up	4.3	±	1.9
meetings	5.0	±	2.0
previewing audio visual material	5.1	±	2.0

* Items were ranked from 1 (most time) to 7 (least time)

preparation time if it were provided. The activity that ranked the highest was planning new units followed closely by preparing existing units. The activities teachers were least likely to use additional preparation time for included committee work and relaxing. Again, these differences may not be significant given the large standard deviation. Table 2 contains the complete ranking of how these science teachers predict they are most likely to use additional preparation time.

Time

Since additional preparation time is not available to most teachers they must find that equivalent amount of time outside the school day to do what is necessary. Teachers were asked to indicate the number of minutes per day they spent on school duties, both those activities related to science class and other responsibilities. Middle school science teachers in Kansas spend an average of 62 minutes per day (mean = 61.55) on their science classes above and beyond the regular work day. Answers to this question ranged from 0 to 240 minutes. Fifty per cent of the responses fell between 30 and 70 minutes. Twenty percent were below 30 minutes and 30% were over 70 minutes per day. The written comments indicated that most of this time was spent grading papers and the time could vary greatly if a test was just administered or semester grades were due.

In addition to the time spent on science class responsibilities the teachers also reported the average

TABLE 2

USE OF ADDITIONAL PREPARATION TIME

ITEM	MEAN RANK
plan new units	2.4
prepare existing units	2.7
grade papers	3.1
setting up labs	3.5
consult with professionals	4.3
preview audio visual materials	4.3
other	4.5
do library work	4.6
contact parents	4.8
relax	5.0
committee work	5.8

* Items were ranked from 1 (most likely) to 11 (least likely)

number of minutes per day spent on activities such as coaching, advising, and other non-academic duties outside of the school day. The average was 58 minutes per day (mean = 57.70) with a range from 0 to 240 minutes. In contrast to the amount of time spent on science class responsibilities 50% of the respondents spent less than 35 minutes on these non-academic duties. Another 20% spent 40 - 80 minutes per day on these activities and 30% spent 85 to 240 minutes. Comments indicated that this amount of time varied greatly during the year, especially if someone coached only one or two seasons.

Certification

Teachers were asked to indicate their primary and secondary areas of certification. A weakness existed in this question since it did not allow for multiple answers and some people were certified in more than one area. When more than one area was indicated the first number listed was used. Considering that the distribution of courses taught indicated that roughly even numbers of the three traditional courses (life, earth, and physical science) are taught in Kansas it might be expected that certification would follow a similar pattern. However, biology was the most common area of primary certification; over 44% of the respondents were certified in this area. The second most common area of primary certification was "other." Biology, general science, and "other" were pretty evenly distributed for areas of secondary certification. These results are laid

TABLE 3

PRIMARY AND SECONDARY CERTIFICATION

AREA	% PRIMARY	% SECONDARY
BIOLOGY	44	22
PHYSICS	02	03
EARTH - SPACE	03	12
CHEMISTRY	01	20
GENERAL SCIENCE	13	23
PHYSICAL SCIENCE	07	10
OTHER	28	30

TABLE 4

"OTHER" CERTIFICATION

	Primary	Secondary
AREA	Frequency / %	Frequency / %
physical education	17 / 44%	4 / 17%
elementary education	7 / 18%	0
home economics	4 / 10%	0
English/ journalism	3 / 08%	2 / 09%
all sciences/ nat. sci.	3 / 08%	2 / 09%
history	2 / 06%	3 / 13%
agriculture	1 / 03%	0
mathematics	1 / 03%	2 / 09%
social studies	1 / 03%	2 / 09%
psychology	0	3 / 13%
health	0	2 / 09%
sociology	0	1 / 04%
administration	0	1 / 04%
industrial arts	0	1 / 04%

out in Table 3 with the "other" responses enumerated in Table 4.

Academic Background

Kansas middle school teachers are a reasonably well educated group. The mean for education fell half-way between a bachelor's degree plus 30 credits and a master's degree. The frequencies and percentages for all degrees from bachelors to doctor of philosophy are presented in Table 5.

Professional Organizations

Professional organizations such as the National Science Teacher Association (NSTA) or the Kansas Association of Teachers of Science (KATS) have promoted the concept of science-technology-society for years. Other more general professional organizations such as the National Education Association (NEA) have recently been expressing support for these ideas. Teachers were asked to indicate both whether or not they belonged to any professional organization and if so, did they participate. Only NEA and KNEA had a majority of teachers belonging to them, however, neither had over 50% of the teachers participating. A complete listing of these results can be found in Table 6. "Other" responses were usually local teacher unions or the American Federation of Teachers (AFT).

Reading

Science-technology-society topics do not appear consistently in textbooks and if they do the information is

TABLE 5

ACADEMIC DEGREE

DEGREE	%
BA/BS	15
BA+15	18
BA+30	22
MA/MS	16
MA+15	12
MA+30	03
MA+30+	14
PhD	01

TABLE 6

MEMBERSHIP AND PARTICIPATION
IN PROFESSIONAL ORGANIZATIONS

ORGANIZATION	% MEMBERS	% PARTICIPANTS
KATS	36	31
KNEA	57	46
NSTA	24	14
KAMLE	06	06
NEA	55	31
OTHER	40	27

often outdated so teachers were asked to indicate how often they read a variety of materials that at least identify STS issues. Seventy-one per cent of the teachers indicated that they read a local newspaper daily. No other source was used as often. Almost 90% of the science teachers read a science magazine either weekly or monthly. Science books were read at least monthly by three fourths of the teachers. News weeklies such as Time or Newsweek were read weekly or monthly by 70% of the teachers. Sixty-six per cent read a science education journal monthly or bi-monthly. Forty-five per cent indicated that they never read a national newspaper such as The Wall Street Journal or USA Today.

Textbooks

Textbooks were identified in the literature as one of the reasons teachers do not include STS themes in their courses. Two questions were asked to determine the status of textbook use in Kansas. First, teachers were asked to indicate the per cent of lessons they taught from the book. The mean value for this data indicates that most teachers use their textbook for 51-100% of their lessons. Specific information is reported in Table 7.

Second, they reported what textbooks they were using. Several teachers reported using textbooks that were more than ten years old and one teacher noted that the school uses the 1975 edition by choice! The breakdown of textbooks used in Kansas middle school science classrooms appears in Tables 8-12.

TABLE 7

PER CENT OF LESSON TAUGHT FROM THE TEXTBOOK

% OF LESSONS	% RESPONDING
0 - 25	10
26 - 50	17
51 - 75	38
76 - 100	45

± 1%

TABLE 8

LIFE SCEINCE TEXTBOOKS
CURRENTLY USED IN KANSAS

TITLE	PUBLISHER	%
Life Science	Scott Foresman	30
Focus on Life Science	Merrill	23
Life Science	Holt	11
Modern Biology	Holt	08
Life Science	Silver Burdett	07
Challenges to Sci.: Life Sci.	McGraw-Hill	04
Exploring Living Things	Laidlaw	03
Experiences in Life Science	Laidlaw	02
Life Science	Prentice Hall	01
Life Science	Macmillan	01
Life Science	Addison Wesley	01
Biology	Heath	01
Biology: The Key Ideas	Prentice Hall	01
Biology: An Everyday Experience	Merrill	01
Biology: Living Systems	Merrill	01
Life Science	Heath	01
Life: A Biological Science	Harcourt,Brace & Jovanovich	01

N = 90

TABLE 9

EARTH SCIENCE TEXTBOOKS
CURRENTLY USED IN KANSAS

TITLE	PUBLISHER	%
Earth Science	Scott Foresman	65
Earth Science	Holt	26
Focus on Earth Science	Merrill	23
Earth Science	Silver Burdett	06
Experiences in Earth Sci.	Laidlaw	05
Earth Science	Heath	05
Challenges to Sci.: E.S.	McGraw-Hill	02
Earth Science	Macmillan	02

N = 65

TABLE 10

PHYSICAL SCIENCE TEXTBOOKS
CURRENTLY USED IN KANSAS

TITLE	PUBLISHER	%
Focus on Physical Science	Merrill	35
Physical Science	Prentice Hall	23
Modern Physical Science	Holt	14
Physical Science	Scott Foresman	07
IPS	Prentice Hall	05
Phys. Sci.: The Key Ideas	Prentice Hall	05
Physical Science	Heath	04
Physical Science	Silver Burdett	04
Challenges to Sci.: P.S.	Prentice Hall	02
Physical Science	Macmillan	02

N = 57

TABLE 11

GENERAL SCIENCE TEXTBOOKS
CURRENTLY USED IN KANSAS

TITLE	PUBLISHER	%
Principles of Science Bk 2	Merrill	31
General Science	Holt	19
Exploring Science	Laidlaw	13
Principles of Science Bk 1	Merrill	13
General Science	Scott Foresman	06
General Science	Merrill	06
General Science	Heath	06
Gateways to Science	McGraw-Hill	06

N = 16

TABLE 12

OTHER SCIENCE TEXTBOOKS
CURRENTLY USED IN KANSAS

TITLE	PUBLISHER	%
ISCS (Level I & II)	Silver Burdett	68
Exploring Matter & Energy	Laidlaw	14
Modern Chemistry	Holt	07
Level 6 Science	Heath	04
6th Grade Science	Addison Wesley	04
Modular Activities Program	Houghton Mifflin	04

N = 28

Science-Technology-Society

Teachers were asked four specific questions about science-technology- society:

1) to indicate areas they felt they had enough background to teach;
2) STS topics they currently include in their classes;
3) STS topics they would like to include in their classes; and
4) how supportive they were of the idea of teaching STS.

These first three questions provide interesting information when viewed in parallel as displayed in Table 13. Of particular note are the areas where discrepancies exist, as indicated by the asterisks on the chart. There are marked differences in the per cent of teachers who feel competent (as indicated by background) in certain areas and the per cent who would like to include them. Hazardous substances and nuclear reactors are good examples of this phenomenon. Also of special interest are the areas that a high percentage of teachers have background in and yet a lower percentage include the topic in their curriculum. Human health and disease and water resources are two striking examples of these areas. Appendix H contains the listings of all "other" categories related to Table 13.

The mean response for support of the idea of teaching science-technology- society topics was 3.4 on a 5 point Likert scale. [1=not at all ...5=totally.] This indicates that most teachers surveyed support the teaching of STS

TABLE 13

SCIENCE-TECHNOLOGY-SOCIETY

TOPIC	ENOUGH BKGD	CUR. INC.	WOULD LIKE TO INC.
air quality	58	53	53
energy shortage	66	74***	72*
extinction	62	50	56
hazard. substances	40*	39	66*
health & disease	77**	59	58*
land use	65	49	61
mineral resources	56	57	54
nuclear reactors	33*	52***	58*
population growth	65	43	54
war technology	19*	09	38*
water resources	74**	64	64
world hunger	46	31	55
other (Appendix H)	11	11	31

* low % with background, higher % would like to include
** high % with background, lower % would like to include
*** low % with background, higher % currently include

somewhat. For a more complete breakdown of these statistics please refer to Table 14.

Administrative Support

Teachers were asked three questions to indicate how supportive their administrations were, each becoming more specific. The first was an indication of how much the administration supported change and innovation. On a 5 point Likert scale the mean was 3.3 indicating that administrators (in the eyes of teachers) were somewhat supportive of change and innovation. This rating dropped slightly to a mean of 3.1 when teachers reported the level of encouragement for change and innovation their administrators provided. Finally, the teachers reported how much their administration supported the concept of STS and again the mean dropped slightly; this time to 3.0. It is interesting to note that 41% of the teachers indicated that they did not know how supportive their administrators were of the concept of STS.

Implementation

To get an idea of what material support teachers wanted to enable them to implement new ideas, teachers were asked three questions. First they responded yes or no to a list of items to indicate what they considered necessary to add new units to the curriculum. These results are reported by percent of respondents indicating "yes, that would help" in Table 15. Only two items received "yes" responses from more than 50% of the sample: more preparation time during the

TABLE 14

TEACHER SUPPORT FOR SCIENCE-TECHNOLOGY-SOCIETY

LEVEL OF SUPPORT	%
TOTAL	12
A LOT	40
SOME	40
A LITTLE	06
NONE	02

TABLE 15

WHAT IS NEEDED TO IMPLEMENT NEW UNITS

ITEM	% RESPONDING YES
more prep time	55
updated resources	53
fewer students	46
release time	44
extended contract	42
more complete library	41
less admin. work	40
current periodicals	37
new/different textbook	37
more coursework	35
inservice	34
administrative support	30

day and updated resources.

Table 16 takes these same items and depicts the mean rank teachers gave them on a scale from 1 (most helpful) to 13 (least helpful). Not surprisingly, preparation time and curriculum resources were two of the most helpful items. Inservice, more background, and release time also ranked high in comparison to the other items. Appendix I describes the "other" things teachers would like their school districts to provide.

A curious discrepency with this data occurred when the teachers were asked to indicate what resources their schools would need to provide in order for them to learn more about STS topics. Seventy per cent or more of the teachers agreed that release time, seminars, and funding would all be beneficial. In addition, 56% replied that administrative support would be helpful. This item received a low ranking and is last in the list in Table 16. This is the first time administrative support was considered helpful by a majority of the teachers.

All of these data are well supported by the content analysis done on the open ended question: "Describe any other factors that affect your likeliness to implement STS themes." These comments fell into seven categories, all identified in Table 17. Each factor listed is a compilation of a variety of comments as described below.

"Resources" included remarks about a lack of supplies, lab space, funds, or awareness of materials. "Time"

TABLE 16

WHAT IS NEEDED TO IMPLEMENT NEW MATERIALS

ITEM	MEAN RANK	&	STANDARD DEVIATION
more prep time during school day	5.0	±	3.3
inservice in desired areas	5.1	±	3.6
updated curriculum resources	5.1	±	3.5
more coursework	5.6	±	4.3
release time during school year	5.8	±	3.3
fewer students in class	6.1	±	4.3
access to more current periodicals	6.8	±	3.5
a bigger or more diverse library	6.9	±	3.9
less administrative work	7.1	±	4.3
extended contract	7.2	±	4.1
a different textbook	7.4	±	4.0
other	7.4	±	5.1
more administrative support	7.9	±	4.0

* Items were ranked from 1 (more helpful) to 13 (least helpful)

TABLE 17

FACTORS AFFECTING LIKELIHOOD TO IMPLEMENT STS THEMES

ITEM	F	%
Resources	32	33
Time	23	24
Support	17	18
Practicality Ethic	7	7
Background	6	6
Student Interest	5	5
Curriculum Mandate	4	4

N = 96

statements generally implied a lack of adequate time available to either develop materials or fit everything into the time allowed for class.

The "support" comments were any that indicated that STS topics were already included or that the individual supported the concept of STS. "Practicality ethic" refers to statements like "I'd have to see the program first." or "I'd have to see a need for it." These comments tended to indicate that the person was not sure STS was worth investing his/her energy into at this time.

"Background" factors were any comments suggesting that the person wanted to know more about STS themes before he/she would feel comfortable implementing them. The "student interest" remarks were those where teachers indicated that their students would not be interested in science-technology-society topics. And finally, "curriculum mandates" were comments made that bluntly said STS themes are not included because they are not part of our district's curriculum.

Correlations

Three measures of the dependent variables were made. Two indicated support or adoption of STS themes and one indicated implementation of STS themes. All interesting correlations with 2-tailed level of significance below .05 are described below. All of these correlations were positive.

A relationship between likelihood to include STS topics

and membership and participation in professional organizations exists, as well as between likelihood and amount of background in science-technology-society issues.

A relationship between participation in professional organizations and several variables was noted. Among them were minutes spent on class duties outside of school, belonging to an organization, background in STS, and years of teaching experience. Some of these relationships seem obvious, i.e., belonging to an organization and participating in one. Others are intriguing, such as background in STS areas. Are people who are active in their profession more aware of current themes?

A number of very obvious relationships exist between age and experience and related variables. But there were also some very high correlations between administrative support and encouragement and individual support for the concept of STS. Age also had a strong positive correlation with how many STS topics were already implemented.

Amount of background in STS areas correlated strongly with the level of support for the idea of teaching STS themes in science courses. Awareness of the topic was apparently a critical factor in how much someone will support a concept.

Please refer to Appendix J for the complete correlation matrix.

Regressions

Stepwise Regression

Three stepwise regressions were run. The first tested the dependent variable "adoption of STS themes" as depicted by survey question 16. Only one variable was significant at the .05 level: belonging to a professional organization. This variable explained 11% of the variance. Please refer to Table 18 for more complete statistical information about this regression.

Survey question 23 also addressed the dependent variable of adoption. Two independent variables accounted for a significant portion of the variance in this question. Administrative support for the concept of STS (as perceived by the teacher) explained 41% of the variance. Amount of background accounted for another 4% resulting in a total of 45% of the variance of the dependent variable "adoption" being explained when teachers are asked to directly state their level of support as in question 23. Table 19 contains the complete results for this regression.

The other independent variable tested was that of implementation or how much STS was already a part of the curriculum (see survey question 18). Two variables explained 30% of the variance here. First background was most significant, accounting for 24% of the variance. Age explained another 6% of the total variance. The complete results of this regression can be seen in Table 20.

TABLE 18

STEPWISE REGRESSION

Analysis of Variance

STEP 1:

Multiple R	.33191		df
R Square	.11016		
Adjusted R Square	.09727	Regression	1
Standard Error	3.66026	Residual	69

Sum of Squares	Mean Square
114.44597	114.44597
924.42727	13.39750

F = 8.54234   Signif. F = .0047

Dependent variable: Adoption (SQ 16)

Independent variable: Belonging to a Professional Organization

TABLE 19

STEPWISE REGRESSION

Analysis of Variance

STEP 1:

Multple R	.64316		df
R Square	.41366		
Adjusted R Square	.40526	Regression	1
Standard Error	.56655	Residual	70

Sum of Squares	Mean Square
15.85126	15.85126
22.46819	.32097

F = 49.38484 Signif. F = .0000

STEP 2:

Multple R	.67272		df
R Square	.45255		
Adjusted R Square	.43669	Regression	2
Standard Error	.55139	Residual	69

Sum of Squares	Mean Square
17.34165	8.67083
20.97779	.30403

F = 28.52002 Signif. F = .0000

Dependent variable: Adoption (SQ 23)

Independent variable 1: Administrative support for STS (SQ 22)

Independent variable 2: Teacher background knowledge (SQ 15)

TABLE 20

STEPWISE REGRESSION

Analysis of Variance

STEP 1:

			df
Multiple R	.48660		
R Square	.23678		
Adjusted R Square	.22587	Regression	1
Standard Error	2.67430	Residual	70

Sum of Squares	Mean Square
155.31205	155.31205
500.63240	7.15189

F = 21.711622 Signif. F = .0000

STEP 2:

			df
Multiple R	.55213		
R Square	.30485		
Adjusted R Square	.28470	Regression	2
Standard Error	2.57069	Residual	69

Sum of Squares	Mean Square
199.96323	99.98162
455.98121	6.60842

F = 15.12942 Signif. F = .0000

Dependent variable: Implementation (SQ 18)

Independent variable 1: Background

Independent variable 2: Age

Full Regression

The full regression technique sorts all of the independent variables according to significance and then enters each in order of decreasing tolerance one step at a time into the regression equation to produce a percentage indicating the total variance accounted for by all of the variable together. This technique does not account for the amount of shared variance as stepwise regression does.

For these three regressions the following independent variables were entered: per cent of lessons taught from the textbook, age, number of planning periods per week, background, administrative support, time spent on class outside the school day, participation in a professional organization, academic degree, teacher support for STS, all teaching experience, administrative support of STS, membership in professional organizations, science teaching experience, and administrative encouragement.

All of these variables together explained 31% of the variance of the dependent variable of adoption as measured by survey question 16 at a .07 level of significance. These same variables explained 51% of the variance of adoption as measured by survey question 23 at a .00001 level of significance. Forty four percent of the variance of the dependent variable implementation, was explained by this group of variables at a .0009 level of significance. Please refer to tables 21, 22, and 23 for more complete information.

TABLE 21

FULL REGRESSION

Analysis of Variance

Multiple R	.55499		df
R Square	.30801		
Adjusted R Square	.13501	Regression	14
Standard Error	3.58292	Residual	56

Sum of Squares	Mean Square
319.98245	22.85589
418.89079	12.83734

F = 1.78042 Signif. F = .0651

Dependent variable: Adoption (SQ 16)

TABLE 22

FULL REGRESSION

Analysis of Variance

Multiple R	.71370		df
R Square	.50936		
Adjusted R Square	.39939	Regression	13
Standard Error	.56935	Residual	58

Sum of Squares	Mean Square
19.51848	1.50142
18.80096	.32415

F = 4.63181 Signif. F = .0000

Dependent variable: Adoption (SQ 23)

TABLE 23

FULL REGRESSION

Analysis of Variance

			df
Multiple R	.66351		
R Square	.44024		
Adjusted R Square	.30275	Regression	14
Standard Error	2.53803	Residual	57

Sum of Squares	Mean Square
288.77263	20.62662
367.17181	6.44161

F = 3.20209 Signif. F = .0009

Dependent variable: Implementation (SQ 18)

Factor Analysis and Regression

Stepwise regression and full regression do not account well for variables that are similar and may cluster so a factor analysis was performed. After the regular orthogonal factor analysis was run, one rotation was also computed. This rotation produced more reasonable results so these factors were entered into stepwise regressions with the three dependent variables.

Nine factors evolved with clusters of 1 to 3 variables. The following list relates the factor number to a name describing the cluster of variables associated with it.

F1 Experience
F2 Administrative support
F3 Time available
F4 Belonging to and participating in professional organizations
F5 Background
F6 Items needed to enable implementation
F7 Use of prep time
F8 Area of certification
F9 Planning time

Factor 4, membership and participation in a professional organization, explained 4% of the variables of adoption as measured by survey question 16 at a .02 level of significance.

Factor 1, experience, factor 5, background, and factor 2, administrative support, together, explained 24% of the variance of adoption as measured by survey question 23 at the .00005 level of significance.

Factor 1, experience, also explained 3% of the variance of implementation as measured by survey question 18 at a .02

level of significance. Please refer to tables 24, 25, and 26 for the complete statistics on these regressions.

Rejection or Acceptance of Hypotheses

Hypothesis 1: There is no relationship between middle school science teachers adopting STS themes in their curricula and preparation. Time does not seem to influence whether or not teachers adopt STS themes as indicated by these results. Either time truly is not a factor of adoption or no appropriate question was asked to measure and interpret this relationship. Whether time in relationship to adoption was not appropriately measured or whether it does not affect adoption this hypothesis was accepted since there was no evidence to refute it.

Hypothesis 2: There is no relationship between middle school science teachers implementing STS themes in their curricula and preparation time. Time became a major factor when looking at implementation. Table 2, which gives an indication of this factor, reflects that "adding new units" had the highest ranking of activities teachers would use additional prep time for. This is reinforced by the content analysis displayed in Table 17 where time accounted for 24% of the responses describing factors affecting likelihood to implement science-technology-society themes. Hypothesis 2 was rejected.

Hypothesis 3: There is no relationship between middle school science teachers adopting STS themes in their curricula and internal teacher characteristics. The

TABLE 24

REGRESSION AFTER FACTOR ANALYSIS

Analysis of Variance

Multiple R	.19557		df
R Square	.03825		
Adjusted R Square	.03192	Regression	1
Standard Error	3.52335	Residual	152

Sum of Squares	Mean Square
75.04340	75.04340
1886.93063	12.41402

F = 6.04505 Signif. F = .0151

Dependent Variable: Adoption (SQ16)

Independent Variable: Factor 4 (Membership & Participation in Professional Organizations)

TABLE 25

REGRESSION AFTER FACTOR ANALYSIS

Analysis of Variance

STEP 1:

Multiple R	.36765		df
R Square	.13516		
Adjusted R Square	.12962	Regression	1
Standard Error	.89795	Residual	156

Sum of Squares	Mean Square
19.65862	19.65862
125.78442	.80631

F = 24.38096 Signif. F = .0000

STEP 2:

Multiple R	.45077		df
R Square	.20320		
Adjusted R Square	.19292	Regression	2
Standard Error	.86468	Residual	155

Sum of Squares	Mean Square
29.55367	14.77683
115.88937	.74767

F = 19.76376 Signif. F = .0000

STEP 3:

Multiple R	.48530		df
R Square	.23552		
Adjusted R Square	.22063	Regression	3
Standard Error	.84971	Residual	154

Sum of Squares	Mean Square
34.25486	11.41829
111.18818	.72200

F = 15.81478 Signif. F = .0000

Dependent variable: Adoption (SQ 23)

Independent variables: Factor 1 (experience)
Factor 5 (background)
Factor 2 (administrative support)

TABLE 26

REGRESSION AFTER FACTOR ANALYSIS

Analysis of Variance

Multiple R	.18146		df
R Square	.03293		
Adjusted R Square	.02669	Regression	1
Standard Error	2.96042	Residual	155

Sum of Squares	Mean Square
46.25529	46.25529
1358.43261	8.76408

F = 5.27783 Signif. F = .0229

Dependent variable: Implementation (SQ 18)

Independent variable: Factor 1 (experience)

regressions run indicated that internal characteristics accounted for a small percentage of the variance of adoption as measured by this instrument. Specifically, belonging to professional organizations explained 11% in one question while amount of background explained 4% in another question. When the internal factors were grouped during factor analysis they became more significant. One factor, belonging to a professional organization, accounted for 20% of the variance for one measure of the adoption; while two factors, experience and background, explained 45% of the other measure of adoption. How adoption is measured is critical to accounting for the variance. Hypothesis 3 was rejected with the internal characteristics of belonging and participating in professional organizations, experience, and background being identified as important internal characteristics.

Hypothesis 4: There is no relationship between middle school science teachers implementing STS themes in their curricula and internal teacher characteristics. Internal characteristics affected implementation even more than adoption. Background accounted for 24% of the variance here. Hypothesis 4 was rejected with very specific delineations concerning what internal characteristics affect implementation because background knowledge was the only variable identified that accounted for a large portion of the variance. The factor of experience accounted for a very small portion of he variance (3%).

Hypothesis 5: There is no relationship between middle school science teachers adopting STS themes in their curricula and external teacher characteristics. Administrative support for the concept of STS accounted for 41% of the variance of adoption in the initial stepwise regressions. Under factor analysis all of the administrative support variables were lumped and together they accounted for only 3% of the variance of adoption. However, since the first regression explained so much of the variance, Hypothesis 5 was rejected with administrative support being identified as an important external characteristic affecting adoption.

Hypothesis 6: There is no relationship between middle school science teachers implementing STS themes in their curricula and external teacher characteristics. These characteristics were not significant in the regression equations, however, "resources" was the top factor in the content analysis asking teachers to identify factors affecting their likelihood to implement STS themes (see Table 17). Thirty three percent of those responding indicated that a lack of resources was the main reason for not implementing STS themes. Rankings of what teachers thought they needed in order to implement STS themes also highlighted external characteristics. Perhaps the survey did not ask other appropriate questions to test this hypothesis and that is why external factors did not appear to be significant in the regression equations. At the same

time, Hypothesis 6 is neither accepted nor rejected; it will be relegated to the category of "needs further study."

Hypothesis 7: There is no single combination of preparation time, internal teacher characteristics, and external teacher characteristics that best predicts the adoption of STS themes by middle school science teachers. There were several combinations of variables that helped predict the likelihood of adoption. The internal characteristics of background combined with the external characteristic, administrative support, accounted for 45% of the variance in one stepwise regression. One full regression, based on survey question 16, which included all of the variables accounted for 31% of the variance. Another full regression, based on survey question 23, accounted for 51% of the variance. Clearly, there is a combination of variables that predicts adoption, therefore hypothesis 7 was rejected. It remains unclear which particular combination is the best predictor.

Hypothesis 8: There is no single combination of preparation time, internal teacher characteristics, and external teacher characteristics that best predicts the implementation of STS themes by middle school science teachers. Stepwise regression revealed a combination of background, an internal characteristic, and age, an external characteristic, accounted for 30% of the variation in implementation. The full regression accounted for 44% of the variation. A content analysis found that resources,

time, and support were the top three factors affecting likelihood to implement STS themes. Since this variety of analyses all indicated that implementation is, indeed, affected by a combination of variables Hypothesis 8 was rejected.

CHAPTER 5

SUMMARY AND CONCLUSIONS

The primary purpose of this research was to identify the specific factors affecting adoption and implementation of STS themes in middle school science classrooms.

Review of the Problem

Eight hypotheses were tested to begin to identify the internal and external teacher characteristics and the importance of time in the adoption and implementation of STS themes. A great number of sub-variables were included under the headings "internal teacher characteristics" and "external teacher characteristics". This research attempted to sort those out to determine which were more significant in relationship to adoption and implementation of science-technology-society themes. The significant variables were identified by descriptive statistics, content analysis, and multiple regression.

Summary of Findings

Time is a factor that affects implementation but not adoption. This is not a surprising finding since adoption simply requires accepting an idea while implementation requires putting that idea into practice. This finding was also supported by content analysis .

The internal characteristics (those the teacher has control over) affecting adoption or support of the concept

of science-technology-society themes were memberships and participation in a professional organization and background knowledge about various STS topics. These same characteristics showed up in a variety of regression equations and always in conjunction with one or two external characteristics. The internal characteristics accounted for a relatively small portion of the total variance of the dependent variable adoption. On the other hand, implementation was primarily affected by internal teacher characteristics. Background knowledge about STS topics accounted for 24% of the variance of this variable.

External teacher characteristics (those a teacher has no personal control over) also affected adoption and implementation. In particular, the degree of administrative support for the concept of STS accounted for 41% of the variance of the dependent variable adoption. All variables related to experience were combined to form a factor as were the variables related to administrative support. These two factors accounted for 39% of the variance when examined with the multiple regression technique.

The effect of external characteristics on implementation was less pronounced. After factor analysis, 18% of the variance of implementation could be explained by the combined variables related to experience. In the first run of the regression, age was the only external characteristic that was significant and by itself accounted for only 6% of the variance. It is important to note that

content analysis of teachers' comments revealed resources and time as the two major factors preventing the implementation of STS themes in their classrooms. The discrepancy here may be that the instrument was not designed to measure time and resources in a manner that made them easy to use in the multiple regression technique.

Hypothesis Testing

Based on the three major forms of analysis (descriptive statistics, content analysis, and multiple regression), six hypotheses were rejected, one accepted and one tabled. From the information obtained the initial hypotheses can now be refined.

Hypothesis 1: [There is no relationship between middle school science teachers adopting STS themes in their curricula and preparation time.] was accepted so no refinements are necessary.

Hypothesis 2: [There is no relationship between middle school science teachers implementing STS themes in their curricula and preparation time.] was rejected due to the lack of support for this hypothesis in the descriptives and content analysis sections of the data. Rather than refining the hypothesis, the instrument needs to be refined so that time can be measured as a continuous variable which then becomes part of the regression equation.

Hypothesis 3: [There is no relationship between middle school science teachers adopting STS themes in their curricula and internal teacher characteristics.] was

rejected and based on this research the internal characteristics that need closer study are background knowledge, and membership and participation in professional organizations.

Hypothesis 4: [There is no relationship between middle school science teachers implementing STS themes in their curricula and internal teacher characteristics.] was rejected and could be refined to look at background knowledge also.

Hypothesis 5: [There is no relationship between middle school science teachers adopting STS themes in their curricula and external teacher characteristics.] was rejected. The variables that reoccurred most often were administrative support and experience. Generally, one can not change how much experience a teacher has had so a refinement of this hypothesis could examine the subvariables related to administrative support.

Hypothesis 6: [There is no relationship between middle school science teachers implementing STS themes in their curricula and external teacher characteristics.] was neither accepted nor rejected. The particular external variable that seemed to affect implementation the most was resources; but this variable could not be tested as the others were in the multiple regression equation. Since this is a complex variable it provides many areas for refining hypothesis 6. Some possibilities include examining money, materials, or

lab supplies available to the teachers to aid implementation.

Hypothesis 7: [There is no single combination of variables that best predicts adoption of STS themes by middle school science teachers.] was rejected because there were several combinations that helped predict adoption. A particular combination that could be studied further is administrative support and teacher background. No other specific combinations were identified with the type of analysis employed.

Hypothesis 8: [There is no single combination of variables that best predicts implementation of STS themes by middle school science teachers.] was rejected because a number of combinations helped predict implementation. Background and age as well as resources, time, and support were two specific combinations identified. Other combinations may exist but this analysis did not reveal them.

Conclusions

This study identified many interesting variables and relationships of the factors affecting adoption and implementation, particularly in the context of science-technology-society concepts. These relationships will be examined in this section in order to draw conclusions.

The results and conclusions of this research must be confined within the limitations enumerated in Chapter I. It is possible that unidentified extraneous variables are responsible for some of the outcomes. In addition, these conclusions are only generalizable to Kansas middle school science teachers. In addition, it is important to note that since this was an exploratory study no construct validity was done. Therefore it was assumed the survey questions measured what they intended to measure. Generalizations beyond these parameters may not be valid or appropriate.

Time

Teachers put in an average of one hour of academic work and one hour of non-academic work beyond the typical school day and say they need more time made available to be able to implement new units. They would prefer to have this time during the day first in the form of an additional preparation period, and second as release time during the regular school year. An extended contract using the summer months was a third option. This additional time could be used for many activities but teachers ranked adding new

units the most likely use of added time when given twelve other choices.

Internal Teacher Characteristics

All internal factors affecting the adoption and implementation of new ideas were not examined in this study. Of the variety that were studied only two proved to be significant: involvement in professional organizations and amount of background knowledge.

Other factors studied that did not prove to be significant to the adoption and implementation of STS themes include: academic degree, area of certification, amount or kind of reading done, and dependence on the textbook.

External Teacher Characteristics

Administrative support greatly affects adoption but was not as critical in implementation. Rather, the availability of resources and amount of experience were the external characteristics with significance in relationship to implementation.

The external factors that did not prove to be significant in the adoption and implementation of STS themes include time spent outside of class, number of preparation periods, and length of class period.

Implications

The implications of his study apply to several groups: preservice teacher educators, school administrators, leaders of professional organizations, and curriculum developers. Teacher educators of science teachers can use this

information to teach future teachers about the importance of including STS in their curricula. Then the educators can give the students guidance about how to do that when one has a mandated curriculum, outdated textbook, or predetermined textbook series. In addition, training programs should include lots of background in STS areas so teachers are prepared.

Another consideration for teacher education programs is an examination of their certification and graduation requirements. Why are so many science teacher positions filled by people not certified in that area? How can more students be recruited to become science teachers? Should a different type of certification be considered for middle level? Many of these teachers taught three different kinds of science each day. Finally the results of this study indicate the need for more background information to be presented to practicing teachers. Educators who conduct inservice training have a number of topics from which to choose.

The implications for school administrators are also varied. First, there is a clear message that teacher support is directly related to administrative support. If principals or other administrators want something done, they need to be proactive and specific in their support. This study cannot imply much more about this relationship beyond this precautionary level.

The second message to administrators is in the form of

what sorts of assistance teachers find most helpful for implementation. Time is a valuable commodity to teachers. If administrators could find ways to provide more time for teachers more implementation would occur. In addition to time, science teachers need in-service in the STS areas to help them implement these topics.

Leaders of professional organizations should be pleased to see the significance of membership or participation in their associations. Then they should improve their efforts to new members and to distribution of materials and position statements. Ignorance may be one of the factors affecting the implementation of STS themes and professional organizations help reduce this.

Curriculum developers need to be aware of the perceived need for materials dealing with STS themes. If indeed there is a lack of curriculum materials dealing with STS themes then the materials need to be developed. If instead there is a distribution problem, developers need to deal with that. Another important point for developers to keep in mind is that teachers use their textbooks often. In order to have usable materials, developers need to coordinate STS products with and provide a supplement to textbooks or be an integral part of the textbooks, not a chapter in the back of the books.

Science-technology-society concepts are ideas students need to survive in the next century. If people from all facets of education work to encourage implementation of this

conceptual framework, the likelihood that STS becomes a part of every science class will increase.

Recommendations for Further Study

Besides the recommendations and refinements discussed under "Hypothesis Testing" this research raised many questions that could be the basis for further study. If the suggestions described here are insufficient examination of the correlation matrix should provide even more areas for further study.

The exclusion of STS themes from textbooks is an often used excuse to explain why teachers are not including these concepts in their regular curriculum. This study indicated that middle school teachers rely on their textbooks for most of their lessons. The study also tallied what textbooks are used and how widespread that use is. An extension of this information could be content analysis of the most popular books used in Kansas followed by a specific examination of how much STS is actually included. As a follow up to this analysis a curriculum supplement could be developed to fill in the gaps that textbooks create.

In the study of certification occasionally individuals with both science and nonscience certification arose. It would be interesting to see if this type of dual certification increases the likeliness of implementing STS themes. The difficulty of this study would be the low number of individuals who fall into this group.

Another certification study would be the examination of

the effectiveness of science instructors whose primary area of certification is not science. It would also be interesting to find out how well balanced the curriculum is in these classrooms. A similar sort of study could be done of people teaching a branch of science outside their area of specialty.

The individuals who wrote that they would never implement STS themes or those who said they already did implement them could provide two intriguing case studies or one interesting parallel study. There were more people who replied positively than negatively but that could be a bias of the response group rather than an accurate representation. Determining the true representation of support for STS in Kansas specifically could provide another area for study. This has been done in different areas around the country but sometimes a site specific study provides unique data more helpful for inducing change in that area.

All of the general independent variables that were significant to this study could be broken down and examined more closely. Membership and participation in professional organizations lends itself well to this type of study. Which organizations are more effective, local or national? Which type of organizations have more of an impact, general or specific? How can membership and participation be encouraged if it affects schooling in a positive manner? The same sort of breakdown could be done with time and

resources to find out more specifics about these variables and how to keep them from being the roadblocks (or excuses) preventing implementation.

Another set of questions that deserve further study are those where respondents ranked items from most helpful to least helpful. Although the standard deviations did not indicate large differences perhaps there are significant differences between the ends of the scales. Or there may be differences in ranking that depend on the teacher's setting, i.e., administrative support, type of community, size of school and so on.

One final suggestion is in the area of administrative support in relationship to individual support. Is this relationship as strong if studied separately rather than relying on teachers' perceptions of the administrators? If it is strong, how can this relationship be capitalized on to produce better schooling? Does it make a difference what level of administration the support is coming from?

This is only the beginning of a number of areas that could be explored in further study. Any study which is exploratory in nature, as this was, naturally raises more questions than it answers. One last suggestion for further study is to examine the same questions this study attempted to answer based on the new limitations this study and its instrument encountered. These same questions can be refined and studied using another methodology, for example case studies or interviews.

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APPENDICES

APPENDIX A

Content Validation Cover Letter, Validation Instrument, and Results

KANSAS STATE UNIVERSITY

Department of Curriculum and Instruction

College of Education
Bluemont Hall
Manhattan, Kansas 66506
913-532-5550

March 30, 1986

Dear:

I am conducting a survey of Kansas middle school science teachers as a part of the research for my master's degree. I have chosen the "panel of experts" method to validate this survey and would appreciate your input.

The survey questions are designed to answer four research questions and collect some basic demographic information. The research questions are:

1. What is the relationship between the amount of teacher preparation time and the adoption of science-technology-society (STS) themes?
2. What is the relationship between the amount of teacher preparation time and the implementation of science-technology-society (STS) themes?
3. What is the relationship between teacher characteristics and the adoption of STS themes?
4. What is the relationship between teacher characteristics and the implementation of STS themes?

The data will be analyzed using the multiple regression technique within the SPSS package. I am trying to systematically begin to answer the question "Why aren't more teachers including STS themes in their curriculum?" by first looking at factors directly influencing teachers and directly under their control.

Teacher characteristics for this study are generally defined as the internal and external factors that affect a teacher's curricular decisions. Internal factors are those controlled primarily by the individual teacher. External factors are those which have a direct influence on the teacher but are not under his or her direct control. More specifically, features like amount of education and willingness to talk to other teachers are internal factors, while administrative support and professional involvement are external factors.

Teacher preparation time is defined as the number of minutes available each week to a teacher to prepare new materials, grade papers, or take care of other classroom related business.

I would appreciate your assistance in validating the content of the survey. There is a checklist as well as a return envelope enclosed to aid you in this process. Thank you very much for your time and effort.

Sincerely,

Janet Carlson Powell	Emmett Wright
Graduate Student	Professor of Science Education
Science Education	Advisor

CONTENT VALIDATION INSTRUMENT

Please rate the following aspects of the survey according to the designated scales. Place your response number on the line to the right of the question.

3.8 1. Degree of representativeness of items from the possible pool of items as far as STS topics available for middle school science students.

(1) totally unrepresentative
(2) somewhat representative
(3) representative
(4) well representative
(5) totally representative

3.6 2. Degree of representativeness of items from the possible pool of items as far as teacher characteristics relative to adoption and implementation.

(1) totally unrepresentative
(2) somewhat representative
(3) representative
(4) well representative
(5) totally representative

4.0 3. Degree of relevance to the needs of the study.

(1) totally irrelevant
(2) somewhat irrelevant
(3) relevant
(4) quite relevant
(5) totally relevant

4.2 4. Degree of clarity of items.

(1) totally unclear
(2) somewhat unclear
(3) clear
(4) above average
(5) very clear

Comments:

APPENDIX B

Panel of Experts

APPENDIX B

NAMES AND AFFILIATIONS OF "PANEL OF EXPERTS"

Dr. Irma Jarcho
Teachers Clearing House for Science and Society Education
210 East 77th Street
New York, NY 10021

Dr. Rodger Bybee
BSCS
The Colorado College
Colorado Springs, CO 80903

Dr. Robert Yager
Science Education Center
University of Iowa
Iowa City, IA 52242

Dr. Ronald Bonstetter
Department of Curriculum and Instruction
University of Nebraska
Lincoln, NE 68588

Dr. Dorothy Rosenthal
Rush-Henrietta Central School District
Henrietta, NY

APPENDIX C

Survey of Adoption and Implementation of
Science-Technology-Society Themes in Kansas Middle School
Classrooms

ADOPTION AND IMPLEMENTATION OF SCIENCE-TECHNOLOGY-SOCIETY THEMES IN KANSAS MIDDLE SCHOOL SCIENCE CLASSROOMS

PART I

Answer questions 1-11 with the whole number that best represents your answer. Please put your answers in the blank on the right side of the page.

1. Number of planning periods scheduled for you per week.........._______
2. Average number of minutes per planning period.................._______
3. Gender............(enter 1 for female and 2 for male).........._______
4. Number of different class preparations you have per day........_______
5. Number of periods in your school day..........................._______
6. Number of grade levels in your building........................_______
7. Length of class period (in minutes)............................_______
8. Length of lab period (even if the same as number 7)............_______
9. Please indicate the number of sections of science you are currently teaching in each area:

    life science.._______

    earth science..._______

    physical science.._______

    general science..._______

    other: (please specify)__________________________......._______

10. Number of minutes per day you spend on science class responsibilities outside of school day........................._______
11. Number of minutes per day you spend on non-science class responsibilities outside of school day (coaching, advising, clubs, etc.).._______

PART II

Please indicate a positive response to questions 12-17 by putting a one (1) in the blank and a negative response with a zero (0).

12. In order to add new units to my existing curriculum I need:

more coursework... ______

inservice... ______

more prep time during the school day...................... ______

release time during the school year....................... ______

extended contract (paid time before/after school is in session).. ______

new or updated curriculum resources....................... ______

a more complete or diverse library........................ ______

access to more current periodicals........................ ______

more administrative support............................... ______

a new or different textbook............................... ______

less administrative work.................................. ______

fewer students in class................................... ______

13. I belong to:

KATS.. ______
KNEA.. ______
NSTA.. ______
KAMLE... ______
NEA... ______
OTHER (please specify)______________________________...... ______

14. I participate in:

KATS.. ______
KNEA.. ______
NSTA.. ______
KAMLE... ______
NEA... ______
OTHER (please specify)______________________________...... ______

15. Indicate the STS areas you feel you have enough background to teach:

air quality and atmosphere................................ ______

energy shortages.. ______

extinction of plants and animals.......................... ______

hazardous substances...................................... ______

human health and disease.................................. ______

land use.. ______

mineral resources... ______

nuclear reactors.. ______

population growth... ______

war technology.. ______

water resources... ______

world hunger and food resources........................... ______

other....(please specify)____________________________.... ______

16. Indicate all the STS areas you would LIKE to include in your curriculum:

air quality and atmosphere................................ ______

energy shortages.. ______

extinction of plants and animals.......................... ______

hazardous substances...................................... ______

human health and disease.................................. ______

land use.. ______

mineral resources... ______

nuclear reactors.. ______

population growth... ______

war technology.. ______

water resources... ______

world hunger and food resources........................... ______

other....(please specify)____________________________.... ______

17. If you wanted to learn more about Science-Technology-Society topics your school system would need to provide:

release time.. ______

seminars.. ______

funding... ______

administrative support.................................... ______

other......(please specify)____________________________.... ______

18. Indicate all STS areas that you currently include in your curriculum:

air quality and atmosphere................................ ______

energy resources.. ______

extinction.. ______

hazardous substances...................................... ______

human health and disease.................................. ______

land use.. ______

mineral resources... ______

nuclear reactors.. ______

population growth... ______

war technology.. ______

water resources... ______

world hunger and food resources........................... ______

other (please specify).................................... ______

PART III

For questions 19-31 please put the number that corresponds best to your answer in the blank to the right of the question.

19. Please indicate how often you read each of the following using the descriptors below:

daily.......1	local newspaper............. ______
weekly......2	national paper.............. ______
monthly.....3	science books............... ______
bi-monthly..4	science ed. journals........ ______
6 months....5	news weeklies............... ______
yearly......6	science magazines........... ______
never.......7	other (please specify) ______

20. My administration generally supports change and innovation.... ______

not at all..1	a lot..........4
a little....2	totally........5
some........3	I don't know...6

21. My administration generally encourages change and innovation.. ______

not at all..1	a lot..........4
a little....2	totally........5
some........3	I don't know...6

22. My administration supports the concept of STS................ ______

not at all..1	a lot..........4
a little....2	totally........5
some........3	I don't know...6

23. I support the idea of teaching science-technology-society themes in science courses:.................................... ______

not at all..1	a lot..........4
a little....2	totally........5
some........3	

24. Age...............(in years).................................. ______

20-25.......1	46-50..........6
26-30.......2	51-55..........7
31-35.......3	56-60..........8
36-40.......4	61-65..........9
41-45.......5	over 65.......10

25. Total number of years of teaching experience................. ______

0-5.........1	16-20..........4
6-10........2	21-25..........5
11-15.......3	over 25........6

26. Total number of years of science teaching experience.........._______

0-5.........1	16-20..........4
6-10........2	21-25..........5
11-15.......3	over 25........6

27. Academic degree (enter the number associated with your highest degree)....................................._______

BA/BS........1	MA/MS + 15.......5
BA/BS + 15...2	MA/MS + 30.......6
BA/BS + 30...3	MA/MS + 30+......7
MA/MS........4	PhD/EdD..........8

28. My primary area of certification is..........................._______

biology......1	chemistry........4
physics......2	general science..5
earth-space..3	physical science.6
	other............7 _______________

29. My secondary area of certification is........................._______

biology......1	chemistry........4
physics......2	general science..5
earth-space..3	physical science.6
	other............7 _______________

30. Number of students in your building..........................._______

0-100........1	301-500..........4
101-200......2	501-1000.........5
201-300......3	over 1000........6

31. Number of students in your district..........................._______

0-200........1	601-1000.........4
201-400......2	1001-2000........5
401-600......3	over 2000........6

32. Percentage of lessons you teach each week from the textbook..._______

0-25%......1	51-75%......3
26-50%.....2	76-100%.....4

PART IV

For questions 33-35 please rank each group according to the instructions.

33. Please rank from 1 (most helpful) to 13 (least helpful) what you need to implement new curriculum materials:

more coursework..______

inservice in desired aress.............................______

more prep time during the school day...................______

release time during the school year....................______

extended contract (paid time before/after school is in session)...______

updated curriculum resources...........................______

a bigger or more diverse library.......................______

access to more current periodicals.....................______

more administrative support............................______

a different textbook...................................______

less administrative work...............................______

fewer students in class................................______

other (please specify)______________________.......______

34. Please rank from 1(most time) to 7(least time) how you usually spend your preparatory time:

cleaning up..______

grading..______

meetings...______

planning new units.....................................______

preparing existing units...............................______

previewing audio visual materials......................______

setting up or preparing labs...........................______

other:(please specify) ______________________.......______

35. Please rank from 1(most likely) to 11(least likely) how you would be likely to use additional preparatory time if it was added to your schedule:

administrative details.................................... ______

committee work.. ______

contact parents... ______

consult with professionals (teacers, scientists, admin.)... ______

do library work... ______

grade papers.. ______

plan new units.. ______

prepare exiating units.................................... ______

preview audio visual materials............................ ______

relax... ______

setting up labs... ______

other: ____.......... ______

PART V

Please answer the questions completely.

36. List the title, author, publisher, and edition of your primary textbook:

37. Please list other major curriculum materials you rely on regularly:

38. Describe any other factors that affect your likeliness to implement STS themes in your curriculum.

If you would like a copy of the results please put an X in the blank_____

Please return completed survey by April 30, 1986 in the enclosed envelope to:

Janet Carlson
Science Education
261 Bluemont Hall
Kansas State University
Manhattan, KS 66506

APPENDIX D

First Cover Letter

KANSAS STATE UNIVERSITY

Department of Curriculum and Instruction

College of Education
Bluemont Hall
Manhattan, Kansas 66506
913-532-5550

April 21, 1986

Dear Science Teacher:

Many reports have been published in the last two years proclaiming a crisis in science education. Right behind these reports came an equal number of suggestions about how to remedy this condition. One of the most prominent suggestions is to make science education more relevant to students by including science-technology-society (STS) themes in the science curriculum.

Generally defined STS means involving students in discussions, field trips, lab work and so forth that emphasizes the use of technology in science, brings up the impact of science on society and vice versa, and shows students how all these things impact on their lives.

In order to complete my masters thesis I need to collect data indicating the degree to which Kansas middle school science teachers include STS in their curriculum and what factors encourage or discourage their utilization. The enclosed survey should take you about fifteen minutes to complete and will aid in my data collection. Every survey is important so I appreciate your cooperation and effort in filling it out and using the enclosed self-addressed stamped envelope to return the survey by April 30, 1986.

Your answers will remain anonymous and I will use general groupings, such as life science teachers or large school teachers, to refer to the results. After the data has been tabulated the original surveys will be destroyed. The results of this study will help science educators plan appropriate preservice and inservice activities to meet the changing needs in science education and address the current crisis. If you would like a copy of the results please check the appropriate box at the end of the survey.

Sincerely yours,

Janet Carlson
Graduate Student
Science Education

Emmett L. Wright
Professor of Science Education
Advisor

APPENDIX E

Reminder Card

May 9, 1986

Dear Science Teacher:

The response to my survey has been quite good, however in order to have statistically significant data I need 70 more responaes. If you would take the time to complete your survey and send it back today I would greatly appreciate your effort. If you have already returned your survey please diaregard this; our letters crossed in the mail. If you need another survey please let me know and I will gladly send you one. Thank you for all your help.

Sincerely,

Janet Carlson Powell
261 Bluemont Hall
Kansas State University
Manhattan, KS 66506

APPENDIX F

Second Cover Letter

KANSAS STATE UNIVERSITY

Department of Curriculum and Instruction

College of Education
Bluemont Hall
Manhattan, Kansas 66506
913-532-5550

May 15, 1986

Dear Science Teacher:

About three weeks ago I sent you a survey concerning middle school science teachers' adoption and implementation of science-technology-society themes in their classrooms. This survey is part of my research at Kansas State University that is required to earn a master's degree. I need 60 more surveys returned in order to have data that is statistically valid. If I do not get these last 60 surveys I will not be able to complete my research. You have been chosen randomly from the list of non-respondents to receive a second survey.

I realize the school year is almost over and you are very busy, however if you could take the time today or tomorrow to complete the enclosed survey and return it in the stamped envelope provided it would make a big difference in my research. I sincerely appreciate your effort and thank you very much for taking the time to complete the survey.

Sincerely,

Janet Carlson Powell

Janet Carlson Powell
Graduate Student
Science Education

APPENDIX G

Courses Taught Other Than Life, Earth, Physical, or General Science

APPENDIX G

"OTHER" CLASSES TAUGHT

Physical Education
Biology
Chemistry
Advanced Junior High Science
Photography
Math
Zoology
Human Sexuality
Home Economics

Physiology
Creative Writing
Chairperson
Physics
Wichita Mountain Study
U.S. History
Computer
Current Events
Health

APPENDIX H

Other STS Topics Teachers Have Enough Background To Teach, or Would Like to Include or Already Include

APPENDIX H

"OTHER" STS COMMENTS

Have Enough Background to Include	Already Include	Would Like
Astronomy & Space	Astronomy & Space	Astronomy
Genetics	Genetics	
Medical Technology		Medical Tech
Ethics in Science	Ethics in Science	
	Nutrition	
	Consequences	
	Drugs & Mental Health	

APPENDIX I

Other Things School Districts Can Provide to Encourage Adoption and Implementation of STS Themes

APPENDIX I

"OTHER" THINGS NEEDED TO ENCOURAGE IMPLEMENTATION

Extension classes at night
Resource information
Free subscription to periodicals
Science journals and magazines
Prep periods
Transportation
Funding for equipment, field trips, class coverage, education
Contact with a few successful teachers who actually teach STS
Teach fewer courses
More authority with students
More space
More time during year to meet disdtrict curriculum
Full year of science
Better equipment

APPENDIX J

Correlation Matrix

Correlation Matrix

CORRELATION, COVARIANCE, 1-TAILED SIG:

	SQ16	SQ1	SQ10	SQ13	SQ14	SQ15	SQ20	SQ21	SQ22	SQ23	SQ24	SQ25	SQ26	SQ27	SQ12
SQ16	1.000 14.841 .999	.102 .462 .199	-.058 -11.657 .315	.332 1.760 .002	.269 1.307 .012	.267 2.996 .012	-.053 -.187 .330	-.098 -.382 .208	-.124 -.451 .152	.010 .029 .466	.182 1.438 .064	.137 .850 .128	.131 .822 .139	.186 1.355 .060	.108 .371 .185
SQ1		1.000 1.387 .999	.159 9.753 .092	.171 .278 .077	.143 .213 .116	-.043 -.147 .361	.012 .013 .459	.036 .043 .382	-.045 -.051 .354	-.063 -.055 .302	.080 .193 .254	.063 .119 .301	.078 .151 .258	.069 .154 .284	.014 .014 .455
SQ10			1.000 2696.570 .999	.239 17.110 .022	.284 18.617 .008	.086 12.957 .239	.057 2.717 .318	.032 1.685 .395	-.087 -4.291 .234	-.043 -1.636 .362	.067 7.093 .290	.104 8.685 .195	.007 .591 .477	.285 27.982 .008	.090 4.186 .227
SQ13				1.000 1.895 .999	.850 1.478 .000	.147 .592 .110	.089 .112 .230	.013 .018 .457	.087 .113 .236	.017 .018 .443	.118 .331 .165	.166 .369 .083	.115 .258 .170	.332 .866 .002	-.128 -.157 .144
SQ14					1.000 1.596 .999	.279 1.029 .009	.027 .031 .412	.001 .002 .495	.055 .066 .325	.036 .033 .384	.214 .553 .037	.246 .501 .019	.231 .477 .026	.358 .855 .001	-.190 -.214 .057
SQ15						1.000 8.507 .999	.111 .297 .177	.109 .321 .183	.217 .599 .015	.326 .702 .003	.121 .720 .158	.170 .800 .078	.216 1.030 .035	.118 .653 .163	.060 .157 .309
SQ20							1.000 .835 .999	.873 .806 .000	.681 .589 .000	.490 .331 .000	.158 .295 .095	.161 .237 .090	.093 .139 .219	.176 .305 .071	-.035 -.029 .386
SQ21								1.000 1.021 .999	.668 .639 .000	.428 .319 .000	.194 .402 .052	.175 .285 .072	.020 .033 .435	.210 .401 .039	-.063 -.057 .300
SQ22									1.000 .895 .999	.646 .451 .000	-.057 -.110 .320	-.077 -.117 .262	-.135 -.209 .130	.005 .009 .483	-.135 -.114 .131
SQ21										1.000 .546 .999	-.095 -.144 .215	-.105 -.125 .191	-.054 -.065 .327	.020 .028 .434	-.173 -.114 .075
SQ24											1.000 4.192 .999	.778 2.568 .000	.640 2.118 .000	.427 1.653 .000	.008 .014 .474
SQ25												1.000 2.600 .999	.815 2.146 .000	.611 1.863 .000	-.010 -.014 .467
SQ26													1.000 2.666 .999	.561 1.731 .000	-.059 -.086 .313
SQ27														1.000 3.577 .999	.017 .029 .444
SQ12														.017 .029 .444	1.000 .800 .999

ADOPTION AND IMPLEMENTATION OF SCIENCE-TECHNOLOGY-SOCIETY THEMES BY KANSAS MIDDLE SCHOOL SCIENCE TEACHERS

by

JANET CARLSON

B.A., Carleton College, 1982

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Curriculum and Instruction

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1986

ABSTRACT

This research was designed to determine why science teachers are not adopting and implementing science-technology-society (STS) themes more often in their classes. Kansas middle school science teachers were surveyed to obtain information to answer this question.

Four specific research questions were asked:

1. What is the relationship between the amount of teacher preparation time and the adoption of science-technology-society (STS) themes?
2. What is the relationship between the amount of teacher preparation time and the implementation of science-technology-society (STS) themes?
3. What is the relationship between teacher characteristics and the adoption of STS themes?
4. What is the relationship between teacher characteristics and the implementation of STS themes?

Teacher preparation time is defined as the number of minutes available each week to a teacher to prepare new materials, grade papers, or take care of other classroom related business.

Teacher characteristics for this study are generally defined as the internal and external factors that affect a teacher's curricular decisions. Internal factors are those controlled primarily by the individual teacher, such as background and academic degree. External factors are those which have a direct influence on the teacher but are not under his or

her direct control, like administrative support and age.

Adoption is the acceptance of an idea. It is the action that preceeds the process of implementation. Implementation is all the events and activities that a teacher or administration goes through in the first few years of trying something new.

The data collected was analyzed using descriptive statistics, content analysis, and multiple regression. After this analysis the following conclusions were reached:

1. The amount of time available did not seem to influence adoption of STS themes.
2. The amount of time available was a major factor affecting the implementation of STS themes.
3. Internal teacher characteristics accounted for a small amount of the variance of adoption of STS topics. Those that seemed to matter were: belonging to a profesional organization and amount of background knowledge about STS topics.
4. Internal characteristics accounted for a larger portion of the variance of implementation of STS themes. Specifically, background knowledge and experience were the characteristics identified.
5. The external factor primarily affecting adoption of STS themes was administrative support for the concept of science-technology-society.
6. The major external factor affecting the implementation of STS themes seemed to be resources, either that they do not exist or that they are not reaching the teachers.